

**Proposed Amendment between California Energy Commission
and
Volvo Technology of America, Inc.**

Title: Gas Optimized Advanced Heavy Duty Engine Concept
Amount: \$0.00
Term: 8 months
Contact: Reynaldo Gonzalez
Committee Meeting: 7/20/2011

Recommendation

Approve this agreement with Volvo Technology of America for \$0.00. Staff recommends placing this item on the consent calendar of the Commission Business Meeting.

Issue

This is an amendment to Agreement Number PIR-08-046 with Volvo Technology of America. The agreement amount is \$999,970, and having a match funding amount by Volvo Technology of America and its partners of \$390,259.

Staff is requesting an eight month no-cost time extension to June 30, 2012. The current term for the grant agreement ends October 28, 2011. This time extension is needed because the contractor, Volvo Technology of America, will not meet one of the technical task objectives in the Scope of Work, specifically "To assess the new aftertreatment system, including heat management on a multi-cylinder production engine," in time and within the project budget. The alternative is to generate corresponding information from simulations using empirical models based on results from extended single cylinder tests. This change requires extending the schedule by eight months, changes location of the subcontracted activity and also results in added benefits by using an alternative process. The benefits include a broader coverage of emissions results relative to real-world driving conditions.

Background

On January 22, 2009, the California Energy Commission PIER Transportation Program released a Program Opportunity Notice (PON) and Application Package for Advanced Heavy-Duty Natural Gas Engine Research & Development Grant Solicitation. The PON announced that up to \$2.7 million was available from the PIER program to fund research and development of advanced natural gas engine concepts for application in heavy-duty vehicles.

To expand awareness of the PON, a pre-proposal workshop was conducted on January 30, 2009. The workshop was conducted live in the Energy Commission's Hearing Room A, in Sacramento, California, and included Webex and teleconference participation. The workshop covered details of the application process and provided a forum to capture questions and answers. The workshop, PON, and questions and answers from the workshop and sent into the Energy Commission prior to the Question Submittal due date, were published on the Energy Commission website on February 18, 2009.

During 2007 and 2008, the Energy Commission conducted an in-depth analysis of the challenges and technology research gaps associated with natural gas engines, vehicles, and fueling systems. The Natural Gas Vehicle (NGV) Research Roadmap identifies the gap between the performance of a natural gas heavy-duty engine and a similar diesel engine in the same vehicle application. Conventional spark-ignited natural gas engines have two fundamental deficiencies - increased fuel consumption and reduced

power density - that hinder their ability to compete with diesel engines despite the lower price of natural gas.

The proposal submittal due date of February 24, 2009, the Energy Commission received 10 proposals requesting \$8,776,538 and providing \$3,889,594 in matching contributions. In accordance with the 2009 Application Package for the Advanced Heavy-Duty Natural Gas Engine Research & Development Grant Solicitation, each proposal was reviewed screened for technical evaluation against the scoring criterion by Energy Commission staff. The Scoring Team reviewed, evaluated, and scored the 10 proposals in March 2009 using the criteria prescribed in the Application Package.

Proposed Work

This research will evaluate and further develop the promising High Pressure Direct Injection (HPDI) technology, which allows natural gas engines to operate at the same high efficiency and high power density as today's heavy-duty diesel engines. Opportunities for cost effectiveness will be addressed using a systematic approach and Volvo's global supply base. The project will accelerate the research and development of an advanced natural gas engine concepts that can be used in the heavy duty vehicles built by the Volvo Group. The overall objective is to develop a natural gas engine concept with diesel engine performance in terms of drivability and efficiency. Potential to further improve fuel efficiency through enhanced in-cylinder mixing will also be investigated.

The HPDI technology will be systematically evaluated using an overall engine system approach. The base engine and the exhaust after treatment system will be adapted and further developed to meet the special requirements of the new combustion technology with the objective to optimize the complete gas engine concept. In a subsequent step, using the experimental developments from the project, the gas engine concept will be implemented in a virtual demonstrator providing means for best possible estimates of the on the road vehicle performance in terms of drivability, efficiency and environmental impact.

The total term of this project will be 34 months. The term of this agreement was originally defined as 26, and is typical for a project of this complexity in heavy-duty natural gas engine design work. The additional eight month is required due to the unanticipated situation where the one of the subcontractor no longer had the appropriate hardware to perform the testing required in one of the technical tasks.

This project was closely coordinated with the Alternative and Renewable Fuel & Vehicle Technology Program whose staff members participated in development of the grant solicitation as well as the review and scoring of proposals. Staff from the South Coast Air Quality Management District and the National Renewable Energy Laboratory also participated as technical reviewers.

The proposed project will accelerate R&D of advanced natural gas engine concepts that can be used in the heavy duty vehicles built by the Volvo Group and, if successful, will contribute substantially to increased adoption of heavy duty natural gas vehicles in the Californian, and more broadly, North American markets by developing the emission performance of the natural gas engine to meet the US10 and additional California Air Resources Board regulations. If it is successful, the Volvo 13 liter engine will contribute substantially to increased adoption of heavy duty natural gas vehicles in the California, and more broadly, North American markets, by developing a highly efficient natural gas engine to meet the US EPA 2010 and California Air Resources Board 2010 regulations.

Justification and Goals

This project "[will develop, and help bring to market] advanced transportation technologies that reduce air pollution and greenhouse gas emissions beyond applicable standards, and that benefit electricity and natural gas ratepayers" (Public Resources Code 25620.1.(b)(1)), (Chapter 512, Statutes of 2006)).

This project also addresses the mandates of SB 1250, under which PIER Transportation invests in advanced transportation technologies that reduce air pollution and GHG emissions beyond applicable standards; the State Alternative Fuels Plan (AB 1007), which calls for conventional motor fuels replacement by 9% in 2012, 11% in 2017, and 26% in 2022; and the 2007 Integrated Energy Policy Report (IEPR), under which the Energy Commission seeks to maximize use of alternative fuels and advance fuels and vehicle technologies.

The objectives of this Agreement are to demonstrate an HD gas engine concept characterized by:

- High fuel efficiency, above 45% brake efficiency.
- High gas/diesel ratio, above 90%.
- Exhaust emissions meeting US 10 and additional California Air Resources Board (ARB) regulations.
- Sustainable level of methane emissions.
- Performance in terms of drivability compared to diesel engine.
- Virtual demonstration of engine concept implemented in vehicle.
- Lowered greenhouse gas emissions by 20% compared to a diesel vehicle.

This will be accomplished by:

- ☐ evaluating and further improving new heavy-duty gas engine technology with the objective to bringing the technologies to market as quickly as possible.